Willingness to pay for biological diversity conservation in Simbu Province, Papua New Guinea.

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Blue hill, Kondiu, Simbu Province. Photo by Eugene Ezebilo, April 2005

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Abstract

Tropical rainforests habitat has been home for many animal and plant species, it displays vast array of visual beauty and ecological diversity. In recent years, economic hardship and rapid population growth have eroded living standards for millions of people in the developing world. To survive, many people have taken steps that are devastating the environment. This paper reports a study focused on the extent of interest people have for the natural environment and willingness to pay for biological diversity conservation in Kegsugl and Kundiawa, Papua New Guinea respectively. The study indicates that very low-income earners are very much concerned, while medium income earners are not much concerned about the natural environment. Primary School leavers in Kegsugl and High School leavers in kundiawa are very much concerned, while Post Secondary School graduates are not much concerned about the natural environment. Furthermore, it was found that income has no statistical significant effect on willingness to pay for biological diversity conservation in Kegsugl, while it has a statistical significant positive effect for Kundiawa. Literacy level has statistical significant positive effect, while sex has no effect for both Kegsugl and Kundiawa respectively.

Key words: Biological diversity, environment, Simbu Province, willingness to pay.

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1. Introduction

In a world of vanishing tropical rainforests Papua New Guinea (PNG) is still a country with vast areas of tropical forest. More than 70 percent of the country is still woodland and large areas of this are covered with original rainforest (Kurschner *et al.,* 1995). Few places on earth rival the diversity of Papua New Guinea (PNG). It has been reported by WWF (2005) that the island of PNG contains more strange, new and beautiful natural objects than any other part of the globe. PNG probably harbours more than 5 percent of the world's biological diversity and many of these organisms are endemic to the region (Hyslop *et al.,* 2005). PNG's forest harbour about 11,000 species of plant and about 60 percent of which are found only in these forests (WWF, 2005). PNG is home to world's biggest butterfly, Queen Alexandra's birdwing (*Omithoptera alexandrae),* birds of paradise (*Paradisaea spp)*, black-capped lory (*Lorius lory*) and Goodfellow's tree kangaroos (*Dendrolagus dorianus notatus*)

In recent years, economic hardship and rapid population growth have eroded living standards for millions of people in the developing world. To survive, many have taken steps that are devastating the environment. Tropical forests are slashed and burned, steep hillsides are farmed, exposing them to wind and water erosion. Arid woodlands are stripped for firewood. Compounding the crisis, governments deep in debt have increased mining, logging and ranching at the expense of forests and farmlands.

The disappearance of large numbers of species and their habitats may have serious consequences. Much that is happening today threatens 'the balance of nature'. According to Global 2000 report, 'hundreds of thousands of species-perhaps as many as 20 percent of all species on earth will be irretrievably lost as their habitats vanish. Since 1950 half of the world's tropical forests have disappeared. In West Africa farmers clear 1,900 hectares of dense forest everyday. In Amazonia a million trees are felled or burnt every hour. A quarter of all Central American forests have been destroyed since 1960 to make way for beef ranching (Chalie, 1984).

The natural – resource mix could shape human productive and social activities. In view of this, the protection of the environment becomes crucial since it could promote sustainable livelihood. The roles and responsibilities of local people in management, conservation and use of the forest cannot be overemphasized since local communities are often dependent on this resource. Furthermore, effort to conserve species not threatened by commercial exploitation almost certainly relies on the co-operation of villagers in rural areas. National parks and game reserves cannot survive when surrounded by a hostile population waiting for any opportunity to move in and exterminate the wildlife. Therefore, it becomes imperative for the people to be aware of the impact their activities could have on the natural environment. The public attitudes

towards the natural environment could either hamper or promote biological diversity conservation. People's behaviour concerning environmental related issues could be linked to the extent of information they have about the environment. If individuals are ill informed it could contribute to overexploitation of the forest resource, thus lowering biological diversity. Similarly, if they are well informed, it could result in sustainable use of forest resources, therefore promoting biological diversity conservation.

1.1. Objectives of the study

Over 85 percent of PNG's population is rural based and most are dependent on subsistence economy such as fishing, hunting and family gardens for livelihood (WWF Pacific, 2005). This implies that conservation of the forest and consequently biological diversity in the country is a necessity for a secured sustainable livelihood. Simbu Province is located in the mountainous region acclaimed by Tolentino (1998) to be home for the greatest wealth of PNG's animal and plant species. The local populace are in the verge of turning their hilly and mountainous topography into gardens that spreads up the side of available hills to feed the teeming population. Population pressure seems to be pushing the people to higher ground at the expense of the remaining forests. New Guinea's birds of paradise have long been treasured for bizarre and colourful plumage. Now they too are on the danger list of extinction (Charlie, 1984). In an attempt to address this dismal situation, this study has been designed to investigate:

1. The extent of interest the people have for the natural environment.

2. Willingness to pay for biological diversity conservation.

2. Materials and methods

2.1. Study areas

The study was performed in Simbu Province located in the interior part of the highlands region (Fig.1), Papua New Guinea (6ºS, 145ºE) in the rainforest zone. Simbu Province has plateaus and mountains that lie within the central mountain system of Papua New Guinea. Mountain Wilhelm, 4509 m, which is the highest mountain in Papua New Guinea, is on the border with Madang Province and West highland Province. Other mountains are Mt Diogene, 3969 m, Mt Bedago, 3774 m, Mt Keragomma, 3661 m and Mt Karimui, 2569 m.

Simbu Province has an area of 8476 km², an estimated population of more than 185,000 and the population density is 43 people / km². The population density of Simbu Province is about four times the average population density of Papua New Guinea (McInnes, 1995). Grasslands cover most of the Wahgi, Koro and Simbu valleys. There are fewer trees because the land has been cleared for the many gardens, which is needed to feed the teeming population. The lower mountains in the southern half of the Province have some forest covering. Alpine grasslands cover the higher areas of kubor range. Hunters have killed most of the wildlife in the Province. There are few birds, except around Mt Karimui. Cuscus, possums and tree kangaroos are rarely seen (McInnes, 1995).

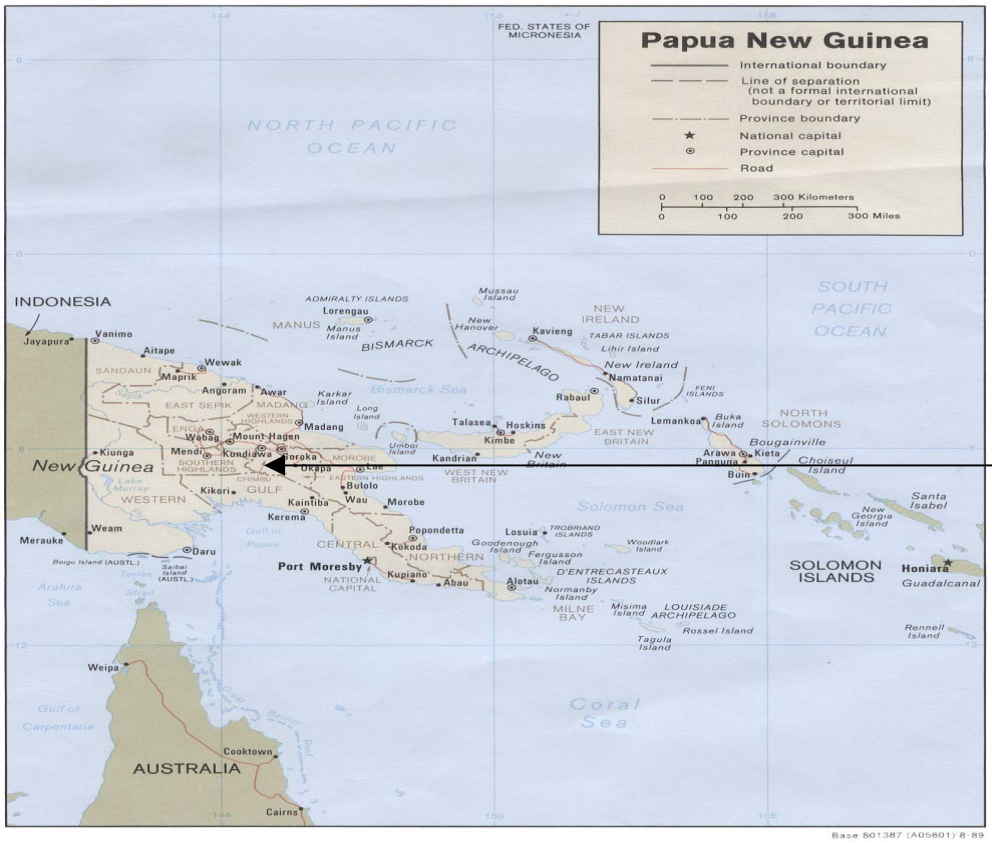

Figure 1.The location of Chimbu / Simbu Province in the map of Papua New Guinea.

2.2. Study design

Two study areas were selected for the purpose of the investigation namely; Kegsugl village and Kundiawa town located in Simbu Province, Papua New Guinea. Kegsugl is the closet village to Mt Wilhelm National Park, home for New Guinea singing Dogs (WWF,PNG., 2004). Mt Wilhelm National Park has been a significant contributor to income for the area from tourists and also basis of subsistence. Since Department of Environment and Conservation closed its operations at Mt Wilhelm National Park about five years ago, the management of the park has been left at the 'mercy hands' of the immediate community or the 'land owners', thus could lend hand to encroachment into the park area. Kegsugl was selected as one of the study area because any efforts to conserve species almost certainly rely on the co-operation of villagers in the rural areas (Morauta *et al*., 1982).

Kegsugl has the population of about 1000 people. Most inhabitants of Kegsugl rely on small-scale agricultural production for subsistence. They mainly cultivate sweet potatoes, broccoli, cabbage and green peas. Pig rearing is very popular in Kegsugl as the number of pigs at the disposal of an individual depicts how wealthy the person is in the community. Some Youths serve as tourist guide and also collect orchids from the forest for sale in the town. Few people serve as classroom teacher in the High school and Primary school.

Kundiawa is the Provincial capital of Simbu, it could be assumed that more influential, and more learned people are residing in the capital town. Moreover, decision and policy concerning the affairs in the Province takes place in the capital town. Kundiawa town has the population of about 5000. Most government offices are located in Kundiawa and most people in Kundiawa town are civil servants, there are also a handful of businessmen in this town.

Questionnaire was handed out to a random sample of 200 respondents in Kundiawa town and 60 respondents at Kegsugl village respectively. The sample was drawn based on stratified random sampling procedure according to the cardinal points. Each study area (Kegsugl village and Kundiawa town) was divided into four sectors (NE, NW, SE, and SW) and four strata were made for each study area based on these directions, and then sampled randomly within each stratum. Questionnaire was randomly handed out to 15 residents in each of the four cardinal points in Kegsugl, while 50 each was handed out in Kundiawa town. 9 and 20 illiterates in Kegsugl and Kundiawa town respectively were helped to fill in the questionnaire based on interview in line with the questions raised in the questionnaire. After two reminders, the total number of respondents to this main questionnaire was 50 for Kegsugl and 130 for Kundiawa town. 48 questionnaires from Kegsugl and 117 from Kundiawa were useable for the purpose of analysis. The questionnaires that could not be used for the analysis has been due to the fact that some of the respondents could not respond to questions like age class, income level and literacy level as shown in Appendix 1, thus making it difficult to classify during the course of analysis.

The main questionnaire, containing 25 questions as shown in Appendix 1 focused on the importance of the forest to the people, how much value the people attach to the forest and human activities in the area that could endanger animal and plant species. Further questions concerned what the natural environment in the area could look like in next 20

years. Several questions dealt with willingness to pay for the protection of the natural environment and conservation of biological diversity. There were questions about willingness to forgo part of the economic activities aimed at restoring endangered plant and animal species. Further questions concerned the willingness for landowners to give up portion of their land for biological diversity conservation, and how much cash (money) the people will be willing to pay for the maintenance of a recreational area such as Mount Wilhelm. The data obtained from the questionnaire were then used for analysing the extent of interest the people have for the natural environment and also the people willingness to pay for conservation of endangered animal and plant species.

The assumption made in the multiple choice questions of the questionnaire has been that options A, B, C and D corresponds to 4, 3, 2 and 1 point scale respectively.

2.3. Statistical analysis

Data generated from the questionnaire was used for estimation of Natural Environment Awareness Score (NEAS) in relation to age, income, literacy and sex of respondents. NEAS could be assumed to depict individual or group of people interest for the natural environment. Therefore, someone that has high NEAS could mean that such individual has greater interest concerning what is happening in the natural environment. Furthermore, for someone to be aware about a particular thing that means the person has interest for the thing, hence NEAS could be used to have clue of the extent of interest an individual or group of people have for the natural environment.

NEAS has been estimated as follows:

$$\frac{\text{Observed score}}{\text{Maximum possible score}} \times 100\ \%$$

Question numbers 8, 9, and16 shown in Appendix 1 has been used for the estimation of Natural Environment Awareness Score (NEAS).

SAS system, GLM procedure was used for regression analysis to investigate the effect that income level, literacy level and sex has on willingness to pay for biological diversity conservation. The hypothesis for the relationship between willingness to pay and income, literacy, and sex is the following:

- **Ho: $R^2 = 0$,** No relationship between willingness to pay for biological diversity conservation and income, literacy, and sex.

- **H_1: $R^2 > 0$,** There is relationship between willingness to pay for biological diversity conservation and income, literacy level, and sex.

Where Ho is the null hypothesis, H_1 is the alternative hypothesis, and R^2 is coefficient of determination.

F test was used to measure the overall significance of R^2 at 5 % statistical significant level (95 % confidence limit). t – test was used to measure the significance of the effect of each individual income level and literacy level on willingness to pay for

biological diversity conservation. Question number 24 shown in the Appendix 1 has been used to investigate the effect of income, literacy and sex on willingness to pay for biological diversity conservation.

In this study, income level is the following;

Very low income = Level 1, Low income = Level 2, Medium income = Level 3,
High income = Level 4

Literacy level is the following;

Not been to school (N/S) = Level 1, Primary school (P/S) = Level 2, High school (H/S) = 3,
Post Secondary (Pt/S) = Level 4.

2. 4. Limitations of the method.

A postal questionnaire was sent to a random sample of 100 Postal office box owners in Kundiawa town. After a reminder, there were no respondents to this main questionnaire. Most inhabitants in Kegsugl village have no access to Postal office box. This has made the author of this work to design strategy for handing out the questionnaire to individual respondents and also help the illiterate ones to fill in the questionnaire in cooperation with an interpreter. Respondents that were helped to fill in the questionnaire may not have supplied the same information if they were to fill in the questionnaire themselves.

It is evident that there has been many reminders to enable respondents fill in the questionnaire, this could have led some respondents to supply information that may not reflect their actual opinion, especially in this case that the researcher have to visit the respondents to remind them. Some of the respondents may feel that the researcher have been a source of stress, in the course of trying to get rid of the researcher; they may fill in the questionnaire for 'filling sake'.

There has been much secrecy concerning income, because most respondents seems not to like been identified according to income level because of security reasons. Therefore, the data generated on income may not be very accurate. Some respondents have not really known the benefit of research, in view of this they could think they are doing favour to the researcher and therefore, supply information just to satisfy the researcher.

3. Results

48 % female and 52 % male responded to the main useable questionnaire in Kegsugl, while it is 44 % female and 56 % male for the case of Kundiawa. 48 %, 25 %, and 27 % very low, low and medium income earners in Kegsugl respectively responded to the questionnaire, while 42 %, 22 %, 27 % and 9 % very low, low, medium and high income earners responded to the questionnaire in Kundiawa. 15 %, 15%, 31% and 40 % not been to school, Primary school leavers, High school leavers and Post secondary school graduates respectively responded to the questionnaire in Kegsugl, while it is 13%, 12 %, 39 % and 36 % for the case of Kundiawa. 25 %, 25 %, 27 % and 23 % of age class 15 – 20, 21 – 30, 31 – 40 and > 40 respectively responded to the main questionnaire in Kegsugl, while it is 26 %, 25 %, 29 %, and 21 % for the case of Kundiawa.

81 % and 79 % respondents from Kegsugl and Kundiawa respectively claim that forest is very important in their life. The forest is very important for 84 % and 74 % female and male respondents in Kundawa, while the forest is very important for 74 % female and 88 % male respondents in Kegsugl. The forest is less important for 3 % respondents in Kundiawa while it is 0 % for Kegsugl.

69 % and 62 % respondents in Kegsugl and Kundiawa respectively attach very high value to the forest. 2 % respondents in Kegsugl attach very little value to the forest, while it is 3 % for the case of Kundiawa.

The most non timber forest products that is used and traded in Kegsugl and Kundiawa are the following: firewood, ferns, bird of paradise feathers, cuscus fur and skin, tree kangaroo, orchids, straw berries, and mushrooms. The degree of people interest for the natural environment in relation to age, sex, income level, and literacy level is presented in figures 2, 3, 4, and 5 respectively.

3.1 People interest for natural environment.

Figure 2. People interest for natural environment in relation to age.

Natural environment awareness score (%) ranges from 50 % (21 - 30 age class) to 92 % (15 - 20 age class) in Kegsugl, while it ranges from 53 % (31 - 40 age class) to 87 % (15 - 20 age class) for Kundiawa as indicated in figure 2. People in the average age class 15 - 20 appear to be very much concerned about the natural environment.

People in the age classes 21 - 30 and 31 - 40 in Kegsugl and Kundiawa respectively seems to be not much concerned about the natural environment.

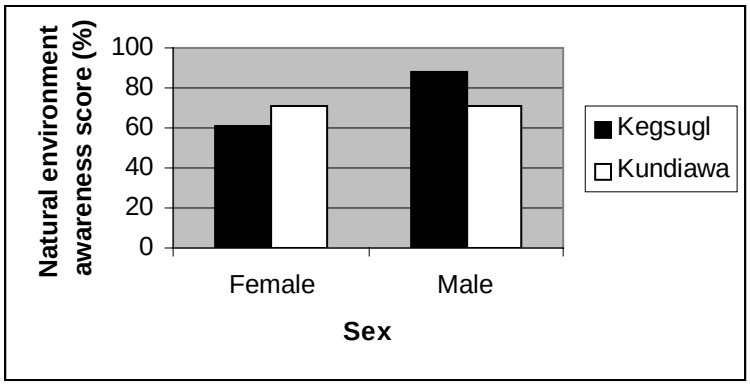

Figure 3. People interest for natural environment in relation to sex.

The male respondents in Kegsugl has higher degree of awareness concerning the natural environment than the female folks, while there is no clear difference between the male and female respondents in Kundiawa as indicated in figure 3. Males in Kegsugl appear to be more concerned about the natural environment than the female and male counterparts in Kundiawa.

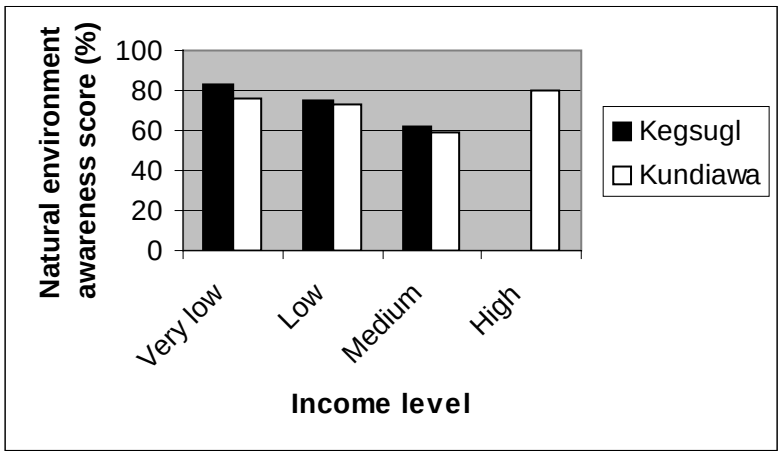

Figure 4. People interest for natural environment in relation to income.

Very low - income earners in Kegsugl have the highest degree of awareness (83 %) about the natural environment, while in Kundiawa high income earners appear to be the most informed (80 %). Surprisingly, medium - income earners have the lowest environmental awareness scores for Kegsugl (62 %) and Kundiawa (59 %) respectively as shown in figure 4. Very low and high income earners in Kegsugl and Kundiawa respectively seems to be very much concerned about natural environment, while medium income earners are not much concerned.

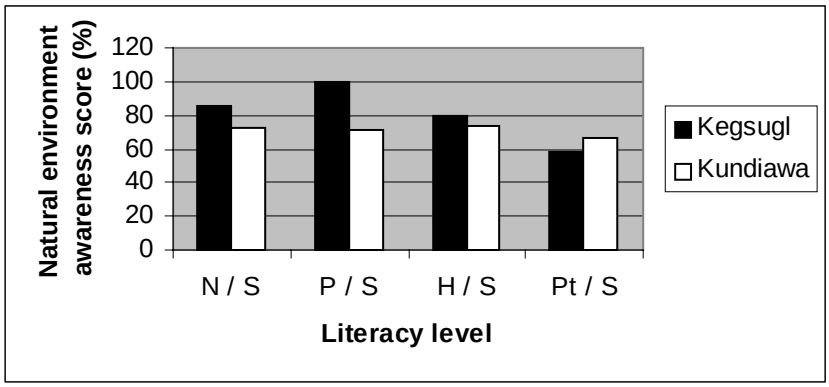

Figure 5. People interest for natural environment in relation to literacy.

Where N / S; Not been to school, P / S; Primary school, H / S; High school, Pt / S; Post secondary school.

Primary school respondents in Kegsugl surprisingly have the environmental awareness score of 100 %, while post secondary school respondents have the least score for both Kegsugl (58 %) and Kundiawa (67 %) respectively as shown in figure 5. Primary school leavers in Kegsugl appear to be very much interested about the natural environment, while post secondary school graduates seems not to be much interested.

3.2 Willingness to pay for biological diversity conservation

The study indicate that 31 % and 38 % respondents in Kegsugl and Kundiawa respectively are not willing to give up environmental protection for economic benefit, while 10 % and 15 % is very willing to give up environmental protection for economic benefit. 48 % and 45 % landowners in Kegsugl and Kundiawa are very much willing to give up portion of their land for restoration of endangered animal and plant species, while 4 % and 2 % respectively are not willing. 33 % and 32% non-landowners in Kegsugl and Kundiawa respectively are very much willing to pay cash (money) for biological diversity conservation, while 17 % and 15 % respectively are not willing.

Very low, low and medium income earners in Kegsugl will be willing to pay average of 7, 7 and 9 PNG Kina respectively for maintenance of a recreational area. For Kundiawa, very low, low, medium and high-income earners will be willing to pay an average of 6, 7, 9 and 10 PNG Kina respectively for maintenance of a recreational area. Literacy levels 1 (N/S), 2 (P/S), 3 (H/S) and 4 (Pt/S) in Kegsugl will be willing to pay an average of 7, 4, 7 and 9 PNG Kina respectively for maintenance of a recreational area, while it is 3, 6, 8 and 9 PNG Kina respectively for the case of Kundiawa. The effect of income level, literacy level and sex on willingness to pay for biological diversity conservation is shown in Tables 1, 2, and 3 below.

Table 1. Effect of income on willingness to pay for biological diversity conservation.

Study area	R^2	F Value	Pr > F	t - values
Kegsugl	0.036	0.840	$0.438^{n.s}$	
Income comparison				
3 – 1				$5.074^{n.s}$
3 – 2				$5.599^{n.s}$
Kundiawa	0.089	3.660	0.0145*	
Income comparison				
4 – 3				$3.928^{n.s}$
4 – 2				6.513*
4 – 1				6.388*

Where income levels 1,2,3, and 4 represent very low income, low income, medium income and high income.
* Statistically significant at 5 % level, n.s: Not statistically significant at 5 % level.

R^2 (coefficient of determination) is greater than 0, in Kegsugl and Kundiawa this indicates a weak relationship between income and willingness to pay for biological diversity conservation in the two studied areas as shown in Table 1, Appendices 2 and 3. It should be noted that the relationship is weak as depicted by the R^2 value. For the case of Kegsugl Pr > F value (0.438) does not fall within 0.05 range, therefore income has no statistical significant effect on willingness to pay for biological diversity conservation. On the other hand, Kundiawa Pr > F value (0.0145) is within the 0.05 range therefore income has statistical significant positive effect at 5% significant level on willingness to pay for biological diversity conservation as shown in Table 1 and Appendix 3 respectively. That is, the higher the income level, the greater will be the willingness to pay for biological diversity conservation in Kundiawa. t – test values for Kundiwa reveal that relationship between income levels 4 - 2, and 4 –1 has statistical significant positive effect at 5 %, while 4 – 3 is not statistically significant for Kundiawa.

Table 2. Effect of literacy on willingness to pay for biological diversity conservation.

Study area	R^2	F Value	Pr > F	t – values
Kegsugl	0.160	2.800	0.051*	
Literacy comparison:				
4 – 3				$4.584^{n.s}$
4 – 1				$6.106^{n.s}$
4 – 2				9.249*
Kundiawa	0.193	8.980	< .0001*	
Literacy comparison:				
4 – 3				3.683*
4 – 2				6.127*
4 – 1				8.516*

Literacy levels 1, 2, 3, 4 represents not been to school, Primary school, High school, and Post secondary school respectively. * = Statistically significant at 5 % level, n.s = Not statistically significant at 5 % level.

R^2 value is greater than 0 for both Kegsugl and Kundiawa respectively therefore there is a weak relationship between literacy level and willingness to pay for biological diversity conservation in the two locations as indicated in Table 2, Appendices 4 and 5 respectively. Pr > F value for Kegsugl and Kundiawa is within 0.05 range indicating that literacy has statistical significant positive effect at 5 % level on willingness to pay for biological diversity conservation in the two studied areas. That is to say, the higher the literacy level, and the greater will be the willingness to pay for biological diversity conservation in Kegsugl and Kundiawa respectively. For the case of Kegsugl, the effect of literacy is fairly significant as indicated by Pr > F value (0.051). Consequently, t – values reveal that only the comparison between literacy levels 4 - 2 has effect on willingness to pay for biological diversity conservation in Kegsugl. For Kundiawa, literacy levels 4 – 3, 4 – 2, and 4 – 1 has statistical significant effect at 5 % level.

Table 3. Effect of sex on willingness to pay for biological diversity conservation.

Study area	R^2	F Value	Pr > F
Kegsugl	0.027	1.270	$0.265^{n.s}$
Kundiawa	0.008	0.890	$0.348^{n.s}$

There is a very weak relationship between sex and willingness to pay for biological diversity conservation for Kegsugl and Kundiawa as shown by the R^2 value in Table 3 and Appendix 6 respectively. However, Pr > F value for the two locations reveal that sex has no statistical significant effect on willingness to pay for biological diversity conservation in Kegsugl and Kundiawa respectively at 5 % statistical significant level.

4. DISCUSSION

The forest seems to be of more important to people residing in Kegsugl than those living in Kundiawa. This could be that Kegsugl is located in rural area and most people in rural area depend on forest and its products for sustainable livelihood. For the case of Kundiawa town the people could have other alternative sources of sustainable livelihood, this could have made the forest not to be as much important as in Kegsugl. Moreover, interests are geared to benefits gained by the stakeholders as reported by Krott (2005). It could be that people in Kegsugl derives more benefit from the forest than people in Kundiawa, hence people in Kegsugl attach more value to the forest than people in Kundiawa.

The age class 15 - 20 in Kegsugl and Kundiawa respectively has the highest natural environment awareness score (about 90%) as evident in Figure 2. It could be that most of the people in this age class (15 - 20) are in High school where they have the opportunity to learn about the natural environment. They could also interact with their parent through story telling, hence learning about past environmental events. In many societies in developing countries it is women and children who collect and transport household fuelwood for cooking, who gather wild fruit nuts and other materials from the forest (Salim and Ullsten, 1999). This could have made the people in the age class 15 - 20 to be very much aware and interested in what is happening to the natural environment. As the age progresses to 21 - 30 years, the people interest seems to be geared more towards economic and technological development hence, becomes less informed about the environment.

At the age of between 31 - 40, it seems that rural dwellers recovers from the dream of technological development and then discovers that the option left for them to earn income is to continue the exploitation of forest resource. In the course of exploitation of the forest resources the people tend to learn more about the natural environment hence, becomes more informed about the environment, but for the case of Kundiawa the age class 31 - 40 seems to be more economic conscious than for the natural environment. At the age class of above 40, environmental awareness score tend to decline in Kegsugl; it could be that at this stage the people mainly rely on information passed to them, because they may not easily migrate to various places to gather information especially in the Highland region where the topography seems to be very rugged. For the case of Kundiawa environmental awareness score increased at age class of above 40, it could be that the people in this age group are already planning to return to the rural area when they retire from active service as depicted by tradition and culture of the Simbu people, hence information concerning the natural environment becomes very crucial for them.

Male population in Kegsugl seems to have the highest environmental awareness score (greater than 80 %) as depicted in Figure 3. It could be that the male population in Kegsugl mainly depend on the forest and its products for source of income, while the male population in Kundiawa could have other alternative sources of income. The female population in Kundiawa seems to have higher environmental awareness score (about 70 %) than female population in Kegsugl (60%). This could be linked to literacy level, it could be that more female population in Kundiawa has higher literacy level than female in Kegsugl thus giving them opportunity to learn more about the natural environment in the school. Moreover, high literate female population seems to be more independent, thus could move freely in the course of gathering information than their

counter parts in the lower literacy level. Female population in Kegsugl tends to have limited migration due to cultural limitation that restricts their movement, hence has lower natural environment awareness score.

Very low-income earners in Kegsugl have the highest natural environment awareness score (83 %) as shown in Figure 4. It could be that they depend solely on forest and its products for income and sustainable livelihood and hence need to know much about the environment. Medium income earners have the least awareness score for both Kegsugl and Kundiawa (62 % and 59 %), this could be that most people in this class has varied alternative sources of income hence, their sustainable livelihood does not solely depend on the forest resource therefore, making them not to be very much informed about the natural environment. Surprisingly, high-income earners in Kundiawa have high awareness score (80 %). This could be that most people in this class are policy makers and head of households. In view of this, to be qualified to settle land driven conflicts as an 'elder statesman', the person shouldering such responsibility need to be familiar with what is happening in the natural environment, hence making the average age class of >45 to be very much informed about environment.

It seems that people with high literacy level tends to engage in activities that has little or no linkage with natural environment and thus have less interest for the natural environment. People with low literacy level seems to engage mainly on activities related to natural environment such as small scale farming, fishing and hunting, thus making them to be more informed about the natural environment as evident in Figure 5.

Generally, the people of Simbu Province seems to be much interested concerning the natural environment, but inadequate definition of property right could render the forest an open access resource thus, could lead to over exploitation of the forest resource resulting in environmental degradation. Absence of proper definition of property and security of tenure renders forests in sub – Saharan Africa an open access resource, thus encouraging unregulated use of the forest resources (Campbell *et al*., 1996). This could also apply to Simbu Province if the present scenario is not checked. For example, at present Mount Wilhelm National Park seems to have no clear ownership, thus leading to open access to the forest resources in the park area.

4.1. Effect of income, literacy and sex on willingness to pay for biological diversity conservation.

Willingness to pay for biological diversity conservation entails making trade offs, especially in terms of forgoing some economic benefits for biological diversity. Optimising benefits in the long term involves making trade offs between benefits, which can be reaped today, and those, which should be left for the future (Higman *et al*., 1999). Income seems not to have statistical significant effect at 5 % level in Kegsugl as shown in Table 1. This could be that most people in Kegsugl attach high value to the natural environment irrespective of income level. The forest and its products could be one of the main source of sustainable livelihood in Kegsugl, therefore most people in Kegsugl could be very much willing to pay for biological diversity conservation to guarantee continuous supply of forest products. Field (1994) reported that powerful motives that could affect demand for different goods include altruism towards friends and relatives, feelings of civic virtue towards their community and a sense of responsibility towards fellow citizens. Therefore, income may not be the main driving

force towards willingness to pay for biological diversity conservation in Kegsugl. On the contrary for Kundiawa, income has positive statistical significant effect at 5 % level (Pr > F 0.0145) on willingness to pay for biological diversity conservation as shown in Table 1. This could be that there has been a wide margin between the income levels, thus giving the people in higher income levels opportunity to be willing to pay more than people in the lower income class. Effect of income on willingness to pay for biological diversity conservation in Kundiawa seems to be in line with Field (1994) who reported that the wealthier a person is, the better that person can afford to pay for various goods and services. Therefore, people at higher income level will be willing to pay more for biological diversity conservation than lower income earners in Kundiawa. Huge disparity on income levels seems to exist between income levels 4 – 2 (t – value, 6.513) and 4 – 1 (t – value, 6.388) in Kndiawa as indicated in Table 1. The positive effect of income on willingness to pay for biological diversity conservation suggests that higher income earners in Kundiawa could have more money to sacrifice. Lower income earners could be struggling to meet the demand of their household and hence has very little to offer for biological diversity conservation.

The statistical significant positive effect at 5 % level of literacy on willingness to pay for biological diversity conservation for both Kegsugl (Pr > F, 0.051) and Kundiawa (Pr > F, > .0001) indicated in Table 2 could be that the higher the literacy level, the more sensitive an individual could be concerning environmental changes and therefore, the greater an individual or group will be willing to pay for biological diversity conservation. The statistical significant positive effect at 5 % level on willingness to pay for biological diversity generated by the relationship between literacy levels 4 – 3 (t – value, 3.683), 4 – 2 (t – value, 6.127) and 4 – 1 (t – value, 8.516) shown in Table 2 seems that literacy level is positively linked to income level in Kundiawa. That is, the higher the literacy level, the higher the income and thus the greater the willingness to pay for biological diversity conservation. Surprisingly, the interaction between literacy levels 4 – 2 in Kegsugl produce significant positive effect at 5 % level (t – value, 9.249) on willingness to pay for biological diversity as depicted in Table 2. This effect seems to have no clear explanation, probably most people in the literacy level 2 fall into the category of people that has very much interest for forest, but not very much willing to pay for biological diversity conservation. Both the female and male population in Kegsugl and Kundiawa respectively make use of the forest and its products in one way or the other, thus they could attach nearly equal value to the natural environment. Therefore, sex seems not to have a statistical significant impact at 5 % level on willingness to pay for biological diversity as reported in Table 3 (Pr > F, 0.265) and (Pr > 0.348) for Kegsugl and Kundiawa respectively.

Number of non - respondents to the main questionnaire shown in Appendix 1 probably may have had effect on the result of the interactions between literacy level 4 –2 in Kegsugl and income level 4 –3 in Kundiawa as shown in Tables 1 and 2. Literacy level 2 in Kegsugl and income level 4 in Kundiawa seems to have the least number of respondents to the questionnaire.

5. Conclusion

Forest resources could minimise the shock of poverty, especially for the rural dwellers. The forest could provide wide range options to very low - income earners to engage in activities that could result in a secure sustainable livelihood. Forest contributes to food security of rural populace by providing varied non - timber forest products such as mushrooms, meat and fruits to supplement products from agriculture production. People in the rural area seem to be very much interested about the natural environment because most of them depend on the forest for sustainable livelihood. Due to very little or no alternatives available for sustainable livelihood for the rural dwellers, they tend to exploit the natural environment even at the expense of the forest ecosystem. It is the marginalisation of the peasantry by the social system and not the behaviour of the peasantry itself, which appears as the ultimate cause of environmental degradation (Ezebilo, 2004). The rapid population growth in Simbu Province requires a lot of caution, because increasing population calls for more mouth to feed and this can only be achieved by breaking new agricultural land as reported by Ezebilo (2004). Shifting cultivation and slash and burn has been the main cropping system in Simbu Province and this is inimical to sustainable forest development and consequently biological diversity conservation. Cleaver and Schreaber (1990) reported that rapid population growth and agricultural sector stagnation in sub-Saharan Africa lead to severe environmental degradation.

Income seems not to be the only factor that determines willingness to pay for a commodity, especially in rural areas. Other factors such as psychological, historical and social values need to be considered. People residing in rural areas should be empowered with the knowledge of sustainable forest management. This could improve the status of biological diversity conservation, because people in the rural areas are dependent on the forest, therefore their activities could have positive or negative impact on biological diversity conservation. Any forest law aimed at biological diversity conservation may be extremely difficult to implement or enforce because most land in Papua New Guinea is communally owned. Any law against the will of the people could be brutally resisted especially, in the spirit of ‘wantok’ (people from the same clan). On the other hand, willingness to pay for biological diversity conservation seems to be income driven in urban areas. The wide gap between high and low-income earners in urban areas should be bridged else; low –income earners could resort to activities detrimental to the natural environment to meet the escalating standard of living in the town.

Vegetation cover, socio – economic growth and development are positively correlated in nations with agriculture and forest based economies (Embaye, 2001). The economy of Simbu Province seem to be agriculture and forest based, therefore, to encourage sustainable development the people should be trained on sustainable agriculture. The people residing in rural areas should be empowered with other skills so that they could have opportunities to engage in other activities apart from agriculture. This could result in a significant reduction of pressure mounted on the natural environment by the increasing population.

This study calls for more research especially on the recreational values of the forest in Papua New Guinea, motivating factors that contribute to willingness to pay for biological diversity conservation in rural areas and appropriate incentives required to encourage rural dwellers to promote biological diversity conservation.

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Appendices

Appendix 1.

Environmental / Biodiversity conservation assessment Questionnaire

This is a survey for an environmental study. Please answer the questions as accurately as possible. Your responses are confidential.
Your help in this study is appreciated.

1. Province_____
2. Name of community_____
3. Occupation_____
4. Age_____(15-20) (21-30) (31-40) (Above 40)
5. Sex_____(Male) (Female)
6. Income level_____(High) (Medium) (Low) (Very low)
7. Literacy level_____(University/college) (Secondary/High school) (Primary school) (Have not been to school)

Please circle the alphabet containing the answer you have chosen and answer the questions that follows.

8. How much important is the forest to you?
   (A) Very important (B) It is important (C) Less important (D) Not important

9. How much value do you attach to the forest?
   (A) Very high value (B) High value (C) Little value (D) Very little value

10. Name any five materials apart from timber that are collected from the forest, used or sold in your community:
    (i)_____ (ii)_____
    (iii)_____
    (iv)_____ (v)_____

11. How many species of large animal such as wild pigs, birds of paradise, cuscus, tree kangaroos etc that you are aware have existed in your community but have disappeared or is about to disappear?
    (A) More than 5 (B) 5 (C) 3 (D) 1

12. How many species of small animal such as butterflies, moths, snails, ants, toads, frogs etc that you are aware have existed in your community but have disappeared or is about to disappear?
    (A) More than 5 (B) 5 (C) 3 (D) 1

13. How many tree species have existed in your community but have disappeared or about to disappear?
    (A) More than 5 (B) 5 (C) 3 (D) 1

14. How many other plant species apart from tree species have existed in your community but have disappeared or about to disappear?

(A) More than 5 (B) 5 (C) 3 (D) 1

15. List at least three human activities in your community that could have led to the disappearance of plant and animal species:
    (i)_____ (ii)_____
    (iii)_____ (iv)_____

16. What is the most environmental problem in your community?
    (A) Deforestation (B) Soil erosion (C) Air pollution (D) Other (Specify:……)

17. How often does the environmental problem lead to economic loss?
    (A) Very often (B) Often (C) Occasionally (D) Rarely

18. Suggest what the natural environment of your community will look like in the next 20 years:
    _____
    _____

19. List at least 4 possible ways of reducing environmental degradation in your community: (i)_____
    (ii)_____
    (iii) _____ (iv)
    _____
    (v) _____

20. Are you willing to give up environmental protection for economic benefit?
    (A) Not willing (B) May not be willing (C) Willing (D) Very willing

21. How much are you willing to forgo economic activities such as Agriculture for the restoration of plant and animal species that is about to disappear in your community?
    (A) Very much (B) Much (C) Little (D) Not at all

22. If you are a landowner, how much are you willing to give up portion of your land for the restoration of plant and animal species that has been disappearing in your community? (A) Very much (B) Much (C) Little (D) Not at all

23. If you are not a landowner, how much are you willing to pay cash for restoration of disappearing plant and animal species in your community?
    (A) Very much (B) Much (C) Little (D) Not at all

24. How much are you willing to pay for the maintenance of a recreational area such as Mount Wilhelm National Park? (A) More than 10 PNG Kina (B) 10 PNG Kina (C) About PNG 5 Kina (D) Nothing

25. Please feel free to pass any other comment here:
    _____
    _____
    _____
    _____

Appendix 2. Regression analysis output for the effect of income on willingness to pay for biological diversity conservation in Kegsugl.

The SAS System, GLM Procedure.

Dependent variable: PNG_KINA

Source	DF	Sum of squares	Mean square	F value	Pr > F
Model	2	34.67	17.33	0.84	0.44
Error	45	928.58	20.64		
Corrected total	47	963.25			

R-Square	Coeff Var	Root MSE	PNG_KINA Mean
0.04	61.59	4.54	7.38

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Income	2	34.67	17.33	0.84	0.44
Source	DF	Type III SS	17.33	0.84	0.44

t Tests (LSD) for PNG_KINA

Alpha = 0.05
Error DF = 45
Error Mean Square = 20.64
Critical value of t = 2.01

Income Comparison	Difference between means	95% confidence limits	
3 – 1	1.90	- 1.28	5.07
3 – 2	1.94	- 1.73	5.60
1 – 3	- 1.90	- 5.07	1.28
1 – 2	0.04	- 3.22	3.29
2 – 3	- 1.94	- 5.60	1.73
2 – 1	- 0.04	- 3.30	3.22

Confidence limit = 95% (5% statistical significant level)

Appendix 3. Regression analysis output for the effect of income on willingness to pay for biological diversity conservation in Kundiawa.

The SAS System, GLM Procedure.

Dependent variable: PNG_KINA

Source	DF	Sum of squares	Mean square	F Value	Pr > F
Model	3	208.70	69.57	3.66	0.02
Error	113	2145.94	18.99		
Corrected Total	116	2354.63			

R- Square	Coeff Var	Root MSE	PNG_KINA Mean
0.09	58.67	4.36	7.43

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Income	3	208.70	69.57	3.66	0.02

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Income	3	208.70	69.57	3.66	0.02

t Tests (LSD) for PNG_KINA

Alpha = 0.05
Error DF = 113
Error Mean Square = 18.99
Critical value of t = 1.98

Income Comparison	Difference between means	95% confidence limits	
4 – 3	0.80	- 2.33	3.93
4 – 2	3.30	0.09	6.51*
4 – 1	3.39	0.40	6.39*
3 – 4	- 0.80	-3.93	2.33
3 – 2	2.50	0.22	4.78*
3 –1	2.59	0.63	4.55*
2 – 4	- 3.30	- 6.51	- 0.09*
2 – 3	- 2.50	- 4.78	- 0.22*
2 – 1	0.09	- 2.00	2.19
1 – 4	- 3.39	- 6.39	- 0.40*
1 – 3	- 2.59	- 4.55	- 0.63*
1 – 2	- 0.09	- 2.19	2.00

* = 5 % statistical significant level.

Appendix 4. Regression output for the effect of literacy on willingness to pay for biological diversity conservation in Kegsugl.

The SAS System, GLM Procedure.

Dependent Variable: PNG_KINA

Source	DF	Sum of squares	Mean square	F Value	Pr > F
Model	3	154.51	51.50	2.80	0.05
Error	44	808.74	18.38		
Corrected Total	47	963.25			

R-Square	Coeff Var	Root MSE	PNG_KINA Mean
0.16	58.13	4.29	7.38

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Literacy	3	154.51	51.50	2.80	0.05

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Literacy	3	154.51	51.50	2.80	0.5

t Tests (LSD) for PNG_KINA

Alpha	0.05
Error Degrees of Freedom	44
Error Mean Square	18.38
Critical value of t	2.01

Literacy comparison	Difference between means	95% confidence limits
4 - 3	1.60	- 1.38 4.58
4 – 1	2.29	- 1.54 6.11
4 – 2	5.43	- 1.61 9.25*
3 – 4	- 1.60	- 4.58 1.38
3 – 1	0.69	- 3.27 4.64
3 – 2	3.83	- 0.13 7.78
1 – 4	- 2.29	- 6.11 1.54
1 – 3	- 0.69	- 4.64 3.27
1 – 2	3.14	- 1.48 7.76
2 – 4	- 5.43	- 9.24 -1.61*
2 – 3	-3.83	- 7.78 0.13
2 – 1	-3.14	- 7.76 1.48

* = Statistical significant at 5 % level.

Appendix 5. Regression analysis output for the effect of literacy on willingness to pay for biological diversity conservation in Kundiawa.

The SAS System, GLM Procedure.

Dependent Variable: PNG_KINA

Source	DF	Sum of squares	Mean square	F Value	Pr > F
Model	3	453.41	151.14	8.98	<.0001
Error	113	1901.22	16.82		
Corrected Total		2354.63			

R – Square	Coeff Var	Root MSE	PNG_KINA Mean
0.19	55.23	4.10	7.43

Source	DF	Type I SS	Mean Square	F Value	Pr > F
Literacy	3	453.41	151.14	8.98	< .0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
Literacy	3	453.41	151.14	8.98	< .0001

t Tests (LSD) for PNG_KINA

Alpha	0.05
Error Degree of Freedom	113
Error Mean Square	16.82
Critical Value of t	1.98

Literacy comparison	Difference between means	95% confidence limits	
4 – 3	1.95	0.21	3.68*
4 – 2	3.62	1.11	6.13*
4 – 1	6.07	3.63	8.52*
3 – 4	- 1.95	- 3.68	- 0.21*
3 – 2	- 1.67	- 0.81	4.15
3 – 1	4.12	1.71	6.54*
2 – 4	- 3.62	- 6.13	- 1.11*
2 – 3	- 1.67	- 4.15	0.81
2 – 1	2.45	- 0.57	5.47
1 – 4	- 6.07	- 8.52	-3.63*
1 – 3	- 4.12	- 6.54	-1.71*
1 – 2	- 2.45	- 5.47	0.57

* = Statistical significant at 5% level.

Appendix 6. Regression analysis output for the effect of sex on willingness to pay for biological diversity conservation in Kegsugl and Kundiawa.

Kegsugl

The SAS System, GLM Procedure

Dependent Variable: PNG_KINA

Source	DF	Sum of squares	Mean square	F Value	Pr > F
Model	1	25.93	25.93	1.27	0.27
Error	46	937.32	20.38		
Corrected Total	47	963.25			

R – square	Coeff Var	Root MSE	PNG_KINA Mean
0.03	61.21	4.51	7.38

Source	DF	Type I SS	Mean square	F Value	Pr > F
Sex	1	25.93	25.93	1.27	0.27

Source	DF	Type III SS	Mean square	F Value	Pr > F
Sex	1	25.93	25.93	1.27	0.27

Kundiawa

Source	DF	Sum of squares	Mean square	F Value	Pr > F
Model	1	18.06	18.06	0.89	0.35
Error	115	2336.57	20.32		
Corrected Total	116	2354.63			

R – square	Coeff Var	Root MSE	PNG_KINA Mean
0.01	60.69	4.51	7.43

Source	DF	Type I SS	Mean square	F Value	Pr > F
Sex	1	18.06	18.06	0.89	0.35

Source	DF	Type III SS	Mean square	F Value	Pr > F
Sex	1	18.06	18.06	0.89	0.35

Confidence limit = 95% (5% significant level)